White Shield
Progressive Solutions, Traditional Values

Lincoln Creek on-site improvements *Findings* at 538 Lincoln St., Walla Walla, WA

• Figure 1- current creek alignment before entering culvert

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INTRODUCTION

This Work appends the Geotechnical Investigation[1] and Geo-Structural Investigation[2] performed for this property. In the aforementioned reports, the impact of the creek alignment contributes significantly to the deterioration of the basement walls and foundation subgrade. The Lincoln Creek improvements will largely mitigate the soil saturation.

This report provides the data necessary to complete the redesign for Lincoln Creek on the property.

SCOPE AND INVESTIGATION APPROACH

For this Work, identification of encumbrances (i.e., alignment and profile of the underground culvert, and other domestic lines such as the Orangeburg sewer pipe in the easement, irrigation, any domestic water, etc.) was required to complete the design of the Lincoln Creek improvements on the site.

The design basis will be a surface conveyance using open channel flow. The underground culvert will be abandoned or removed. Beyond the site horizontal/elevation constraints, the vague easement of the Orangeburg sewer pipe from the property to the south must in considered.

FINDINGS

Methods

Elevations of the culvert pipe inlets, not shown on the topographic survey, and discharge exists were measured with a Ziplevel Pro 2000 using the NW porch area as a reference. Lincoln Creek flow measurements we obtained using a Global Water FP1 11 Water Flow Probe that measures velocity, and using the cross-sectional area, flow can be calculated. Geophysical Survey performed ground penetrating radar (GPR) and sounding (TX 10) location for underground lines. "Sounding" uses a heavy wire probe, that emits a signal to the surface for pipe locations. A portion of the Orangeburg pipe from the cleanout in the SW Corner of the property was investigated with a camera to where the line was damaged.

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[1] Black, M.T., *Geotechnical Investigation for Proposed Remodeling and an Addition at 538 Lincoln St., Walla Walla, WA*, White Shield, October 16, 2021

[2] Black, M.T., *Geo-structural Report for Residence at 538 Lincoln St., Walla Walla, WA*, White Shield, November 1, 2021

• Figure 1-locating turn for culvert with GPR

• Figure 2-excavating to locate Orangeburg pipe

16-inch diameter, concrete, pipe culvert

The attached preliminary base drawing *Lincoln Creek Open Channel Replacement*, Black, 1/7/22 (Drawing) shows the alignment and selected elevations of the culvert. The following general description of the culvert, starting at the inlet at the south of the home follows:

1. The culvert starts at an invert elevation (I.E.) = 991.74 ft. measured by the Surveyor.

2. The culvert travels in a north by northwest direction, *under the Orangeburg sewer pipe* and turns almost due north to near the NW corner of the home. Note an estimated I.E. = 990.91± 0.25 near where the culvert turns toward the adjoining property. This elevation was estimated by using the ground penetrating radar (GPR) estimate of a 3.4 depth to top of culvert (see "Utility Map in Appendix) and subtracting the 3.4 ft. plus a measured distance from the top of culvert to the invert from the surface elevation measured by the Ziplevel Pro.

3. After the culvert turns on the property to the adjacent property, to the west, the culvert discharges at an estimated I.E. = 991.77

Note that the inlet elevations (991.74 and 991.77) are near level. However, the I.E. of the culvert near the turn is approximately 0.86 ft. **below** the inlet and outlet. In other words, the culvert has a "belly" near the center where the creek flows downhill from the inlet and then uphill to the outlet.

• Figure 3-culvert inlet

• Figure 4-flooding of creek on property during moderate rainstorm

• Figure 5-culvert outlet on property to west. Note accumulated sediment

• Figure 6-Culvert outlet on adjoining property. Beyond the accumulated sediment, note the culvert is higher than the creek bed and cobble and boulders are installed to reduce erosion.

• Figure 7-culvert route from property to discharge on property to west

The sounder got stuck near the bend in the sediment and debris. This wire is less than 1/4-in in diameter. Measuring the flows within the culvert was challenging. The Flow Probe is quite accurate, but is limited to velocities above 0.1 ft/sec. While visible flow, albeit limited, at the property inlet, the limitations of the instrument did not allow a measurement as the average flow was less than 0.1 ft/sec. I moved upstream and found an area in the exposed creek with a relatively measurable cross-sectional area. In this area, I measured an average velocity= 0.6 ft/s with a calculated flow of 0.396 ft^3/sec or 177 gal/min.

Moving to the outlet on the adjoining property, I measured an average velocity of 0.4 ft/sec with a calculated flow of 0.193 ft^3/sec or 87 gal/min.

Given some error in the calculation of the cross-sectional areas, **it is inescapable that about 50% of the Lincoln Creek flow is not being transmitted by the pipe. It appears that good amount of the flow is transmitted around the pipe as evidenced by our excavation of the Orangeburg pipe.**

• Figure 8-the Orangeburg pipe is very near the top of the culvert. Significant water was running through the soil into the excavation.

The borehole to check groundwater level was still open and located within 10 ft. of the above excavation. Groundwater was still at over 7 ft. deep indicated most of the flow is within the area of the outside of the culvert and is not adding to the groundwater elevation.

Mr. McVade, Owner of the property to the west, stated that a concrete truck had driven over the portion of the driveway with the concrete culvert. They noticed the pavement sunk when the truck passed over the culvert.

• Figure 9-Culvert inlet showing eroded sidewalls

Fig. 10 is instructive as significant erosion has occurred behind the block lining and around the periphery of the culvert. The orange paint and lathe were installed for warning for pedestrians to not step into the deep eroded holes. This is a strong indicator that significant creek flow is traveling on the outside of the culvert.

Orangeburg sewer line serving property to the south

Scaling from the Drawing, there is approximately 22.5 ft. between the west property line and the home. The Orangeburg sewer line travels near due north at approximately 12 ft. east of the property line. The topographic survey by MGS has the following easement description:

> "THERE IS A SEWER THIS EASEMENT LOCATED SOMEWHERE IN AREA, GRANTED BY AF NO. 8903148, BEING 8 FEET IN WIDTH, RUNNING NORTH TO SOUTH, THE TO BENEFIT TAX PARCEL 360720630327, LOCATION OF WHICH IS UNKNOWN AND NOT DESCRIBED IN SAID DOCUMENT."

Based on our GPR and test pit location data, it appears the easement runs 8 to 16 ft. wide from the west property line. As to elevations of the pipe, the GPR and observation point, the pipe tends to follow a near level path through out most of the property. The standard plumbing code for gravity sewer is ¼ inch drop per foot of pipe. The minimum drop is 1/8 inch/ft. Over 100 ft. the drop would be 25 in. (2.08 ft.) or 12.5 in. (1.04 ft.) respectively. The actual slope appears to be more in the order of 3.1 in (0.26 ft.) over 100 ft.

The table below shows the approximate pipe elevations and distance from the cleanout in the SW Corner of the property.

Distance from cleanout (ft.)	Approximate Surface Elevation (ft.)	Depth to top of pipe (ft.)	Approximate top of pipe elevation (ft.)	Method of depth determination
25	995.75	1.2	993.55	GPR
49	995.25	2.5	992.75	GPR
88	995.5	2.8	992.7	Excavation with tape
204	996.0	2.9	993.1	GPR

The pipe may be 0.4 ft. higher at 204 ft. than at 88 ft. This may be within the area of error given the accuracy of GPR and interpolating between the contours. *It is obvious that the Orangeburg sewer pipe lacks adequate slope.*

During the geotechnical investigation, the Orangeburg pipe was encountered and damaged. At that time, no effluent was discharging from the pipe at it was assumed to service the home and was not in alignment with the locate in the street.

This pipe was repaired with SDR 35 pipe with Fernco couplings during the week of December 27, 2001 by Clark Young Excavators. The photo below shows the repair.

• Figure 10-Orangeburg pipe run repair

Lincoln Creek Surface (open channel flow) approximate demensions.

The walls of the current creek are lined with 6-in high by 18-in. wide by 12-in. deep inch Manor Stone landscaping block. The channel is 1.5 ft. deep by 3.5 ft. wide at the narrowest point. The blocks go to 20 inches deep with 4-in. cap stones.

CONCLUSIONS AND RECOMMENDATIONS

The realignment of Lincoln Creek on this property is constrained by the following:

1. The poorly maintained and perhaps damaged concrete culvert at the property to the west. In other words, a properly designed, constructed, and maintained Lincoln Creek conveyance on the property is limited by the ability of the property, to the west, to accept the full flow of Lincoln Creek.
2. The Orangeburg sewer line in the easement suffers from the following:
   a. The Orangeburg pipe (installations ranging from 1945-1972 has outlived is operating window. The pipe, consisting of bitumen and wood pulp was originally expected to last 50 years. However, problems with manufacturing quality reduced this expectation to an average pf 30 years. At the best case, assuming the pipe was installed in 1972- and 50-years life, *the pipe's longevity has expired this year.*
   b. The pipe lacks the minimum burial depth of 24-inches near the cleanout. Furthermore, cleanouts on 100-ft. centers are recommended for installations.
   c. The pipe lacks adequate slope which was in effect even in the 1950's.

As an upgrade of both the Lincoln Creek culvert on the property to the west and the sewer line in the easement for the property to the south require expenditures by the respective homeowners, we recommend proceeding with a design that does not rely on adjacent homeowner action. Therefore, the following design approach will be followed:

   a. **Lincoln Creek Conveyance**- The culvert will be abandoned and the entry sealed. A conveyance consisting entirely of surface flow via an open-channel conveyance will extend from the Howard Street culvert to the culvert on the adjoining property to the west. If the culvert on the property to the west cannot accept the flow, the surface conveyance on the property would overflow to the property to the west in the area of their culvert.
   b. **Orangeburg pipe easement**- The creek realignment must cross the Orangeburg pipe as some point and extend to the west property line where it will run due north until meeting with the concrete culvert on the property to the west. The pipe crossing must be in a location where the pipe is deep enough to allow the creek realignment to pass over the top. At the crossing area, we would sleeve the existing pipe with a 6-in. PVC pipe and encase the length in concrete to allow line replacement sometime in the future should the property owners to the south require.

In consideration of the above, I judge that we should discuss our plan with the homeowners to the south and west prior starting the final design. With permission of our Client, I would also like to share this report with the adjacent homeowners. Perhaps the homeowners would like to upgrade their utilities in concert with upgrades to this property. If they choose to do so, the design will be more efficient and beneficial to all.

LIMITATIONS

It is important that you understand the limitations of our work and this report. In performing our professional services, we use recognized practices exercised under similar circumstances by members of our profession. No warranty, expressed or implied, is made or intended. Our conclusions and recommendations were developed from our investigation and represent this firm's understanding of the project in concurrence with generally accepted practice. If new relevant information becomes available during the course of or after our investigation, we require the opportunity to review the information and revise our scope and investigation as appropriate.

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Please do not hesitate to contact us should you have questions or comments, and thank you for your confidence in White Shield, Inc.

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APPENDIX


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